New Infrageneric Taxa and Combinations in *Chenopodium* L. (Chenopodiaceae)

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ABSTRACT. Five new subsections and five new combinations of subsectional rank are validated within *Chenopodium* subg. *Blitum* (L.) Hiitonen and *Chenopodium* L. subg. *Chenopodium*. In subgenus *Blitum* these are: *Chenopodium* subsect. *Foliosa* Kowal ex Mosyakin & Clemants; and *Chenopodium* subsect. *Capitata* Kowal ex Mosyakin & Clemants. In subgenus *Chenopodium* the new subsections are: *Chenopodium* subsect. *Polysperma* Kowal ex Mosyakin & Clemants; *Chenopodium* subsect. *Undata* Aellen & Iljin ex Mosyakin & Clemants; and *Chenopodium* subsect. *Standleyana* Mosyakin & Clemants. The new combinations in subgenus *Chenopodium* are: *Chenopodium* subsect. *Urbica* (Standley) Mosyakin & Clemants; *Chenopodium* subsect. *Leptophylla* (Standley) Clemants & Mosyakin; *Chenopodium* subsect. *Fremontiana* (Standley) Clemants & Mosyakin; *Chenopodium* subsect. *Favosa* (Aellen) Mosyakin & Clemants; and *Chenopodium* subsect. *Cicatricosa* (Aellen) Mosyakin & Clemants. Delimitation of some other infrageneric taxa is discussed.

The genus *Chenopodium* L. (Chenopodiaceae) may be subdivided into three natural subgenera: *Chenopodium* subg. *Ambrosia* A. J. Scott, subg. *Blitum* (L.) Hiitonen, and subg. *Chenopodium*.

There has been a fair amount of debate about the proper type for *Chenopodium*. Britton and Brown (1913) were the first to select a lectotype (*C. rubrum* L.), but Hitchcock and Green (1929) adopted *C. album* L. as the lectotype. This later choice has been accepted in recent literature (Jarvis et al., 1993; Greuter et al., 1993; for additional arguments see Uotila, 1993; Mosyakin, 1993), and is thus followed in this paper as well.

The infrageneric taxonomy of the genus has been extensively discussed in several publications (Standley, 1916; Aellen & Iljin, 1936; Kowal, 1953; Aellen, 1960; Scott, 1978). However, in preparing treatments of *Chenopodium* for forthcoming volumes of the *Flora Europae Orientalis* (Mosyakin), the *Flora of North America*, and the *Flora of Japan* (Clemants) it has become evident that new infrageneric taxa and combinations should be validated within *Chenopodium* subg. *Blitum* and *Chenopodium* subg. *Chenopodium*.

Chenopodium subg. **Blitum** (L.) Hiitonen, Suomen Kasvio: 307. 1933. TYPE: *Blitum capitatum* L. (= *Chenopodium capitatum* (L.) Ambrosi (lectotype of the genus *Blitum* L., selected by Britton & Brown, 1913).

If *Chenopodium rubrum* were considered the lectotype of *Chenopodium*, then this would have to be called *Chenopodium* subg. *Chenopodium*. However, if the genus *Blitum* is recognized, this lectotypification of *Chenopodium* by *C. rubrum* may cause serious disruption in the nomenclature of the majority of species currently placed in *Chenopodium*.

Ignatov (1988) redundantly made the same combination at the subgeneric level.

Chenopodium [sect. *Blitum* (L.) Hooker fil.] subsect. **Foliosa** Kowal ex Mosyakin & Clemants, subsect. nov. *Chenopodium* sect. *Eublitum* (Moquin-Tandon) Aellen subsect. *Foliosa* Kowal, Monogr. Bot. (Warszawa) 1: 113. 1953 (invalid name: Polish description); Aellen in Hegi, Illustr. Fl. Mitteleur., ed. 2, 3/2: 577. 1961 (invalid name: German description). TYPE: *C. foliosum* Ascherson (= *Blitum virgatum* L.).

Perianthii segmenta in fructus tempore succulenta (rarius exsucca). Semen margine canaliculatum vel obtusatum. Inflorescentia plerumque foliosa.

Perianth segments succulent at maturity, forming characteristic berry-like clusters (rarely non-succulent). Seeds with canaliculate or obtuse margins. Inflorescence normally leafy (flowering clusters with subtending leaves/bracts almost to the top).

This subsection includes the *C. foliosum* aggregate: *C. foliosum* s. str., *C. exsuccum* (Loscos) Uotila, *C. litwinowii* (Paulsen) Uotila (= *C. korshinskyi*

Litvinov). All members of this subsection are native to the Old World: mostly mountainous regions of Eurasia; however, *C. foliosum* at present occasionally occurs almost worldwide as an escaped, naturalized, or casual alien.

Chenopodium [sect. *Blitum* (L.) Hooker fil.] subsect. **Capitata** Kowal ex Mosyakin & Clemants, subsect. nov. *Chenopodium* sect. *Eublitum* (Moquin-Tandon) Aellen subsect. *Capitata* Kowal, Monogr. Bot. (Warszawa) 1: 113. 1953 (invalid name: Polish description); Aellen in Hegi, Illustr. Fl. Mitteleur., ed. 2, 3/2: 577. 1961 (invalid name: German description). TYPE: *C. capitatum* (L.) Ambrosi (= *Blitum capitatum* L.).

Perianthii segmenta in fructus tempore succulenta (rarius exsucca). Semen acute marginatum vel carinato-marginatum. Inflorescentia plerumque aphylla vel subaphylla.

Perianth segments succulent at maturity, forming characteristic berry-like clusters (rarely non-succulent). Seeds with acute or keeled margins. Inflorescence normally leafless (flowering clusters without subtending leaves or bracts, or with a few bracts only near the base).

Members of this subsection (*C. capitatum* aggregate: *C. capitatum* s. str., *C. overi* Aellen) are New World in origin; *C. capitatum* has been cultivated (especially in Europe), and sporadically occurs as an escaped or casual alien in many countries.

Chenopodium subg. **Chenopodium**

Note. If *C. rubrum* were considered the lectotype for *Chenopodium* (Britton & Brown, 1913), then this subgenus would be in need of a new name or combination.

Chenopodium sect. **Grossefoveata** Aellen & Iljin ex Mosyakin, Ukrayins'k. Bot. Zhurn. 50(5): 75. 1993. *Chenopodium* sect. *Chenopodia* ser. *Grossefoveata* Aellen & Iljin, Fl. SSSR 6: 55. 1936 (invalid name: Russian description). *Chenopodium* sect. *Chenopodium* subsect. *Grossefoveata* Aellen, in Aellen & Just, Amer. Midl. Naturalist 30: 75. 1943 (invalid name: English description); Aellen in Hegi, Illustr. Fl. Mitteleur., ed. 2, 3/2: 577. 1961 (invalid name: German description). TYPE: *C. hybridum* L.

Synonym:

Chenopodium III. *Hybrida* Standley, North Amer. Fl. 21(1): 13. 1916 (name of uncertain rank).

The senior author believes that this section consists of one species with three rather distinct subspecies: *C. hybridum* subsp. *hybridum* (Europe and western Asia; an alien in many other regions); an as-yet-unpublished subspecies (East Asia, with some exclaves in Central Asia and southern Siberia); and *C. hybridum* subsp. *gigantospermum* (Aellen) Hultén (= *C. simplex* (Torrey) Rafinesque; *C. gigantospermum* Aellen; native to North America). Additional morphological justification may be found in Baranov (1964). However, in recent North American literature *C. simplex* is usually recognized as a separate species.

Standley (1916) never mentioned a particular rank for his infrageneric groups of *Chenopodium.* The sectional status of these names is not evident from the context of his work, or from the form and usage of the names. Standley also ignored all previous infrageneric subdivisions within *Chenopodium* and *Atriplex* L. The number of infrageneric groups described by Standley for North American representatives of these two genera (17 for *Chenopodium* and 29 for *Atriplex*) is unusual for traditional sections. In other treatments published in the "North American Flora" series almost simultaneously with the treatment of Chenopodiaceae, such infrageneric names are sometimes referred to simply as "groups" (e.g., Rydberg, 1908). Aellen, who certainly was very familiar with the treatments in "North American Flora," never mentioned in all modifications of his system for *Chenopodium* any of Standley's infrageneric entities, evidently regarding them as informal groups. Under Article 35 of the *Code* (Greuter et al., 1994) they should be regarded as validly published names of uncertain rank (and, subsequently, inoperative in questions of priority), and they may be used as basionyms for new combinations. However, in order to ensure validity of our new taxa and combinations, we provide the formal Latin descriptions for all presumably disputable names.

Chenopodium sect. **Chenopodium**

Synonyms:

Chenopodium sect. *Leprophyllum* Dumortier, Florula Belgica: 21. 1826.

Chenopodium sect. *Chenopodia* C. A. Meyer in Ledebour, Fl. Altaica 1: 403. 1829; Aellen & Iljin, Fl. SSSR, 6: 54. 1936.

Chenopodium sect. *Chenopodiastrum* Moquin-Tandon in A. De Candolle, Prodr. 13, 2: 61. 1849.

Chenopodium [sect. *Chenopodium*] subsect. **Polysperma** Kowal ex Mosyakin & Clemants, subsect. nov. *Chenopodium* sect. *Chenopodia* C. A. Meyer subsect. *Polysperma* Kowal, Monogr. Bot. (Warszawa) 1: 114. 1953 (invalid name: Polish description); Aellen in Hegi, Illustr. Fl. Mitteleur., ed. 2, 3/2: 577. 1961 (invalid name: German description). TYPE: *C. polyspermum* L.

Synonym:

Chenopodium II. *Polysperma* Standley, North Amer. Fl. 21(1): 13. 1916 (name of uncertain rank).

Planta glabra, non farinosa. Folia ovalia vel oblongo-ovalia, integra vel rarissime basi subhastata. Testa nitida, subtilissime punctata.

Plant normally glabrous, not farinose. Leaves ovate or oblong-ovate, entire or rarely subhastate (with two indistinct lobes near the base). Testa shiny, minutely punctate.

The sole member of this subsection, *C. polyspermum*, is a distinctive species with at least two (or three?) distinct varieties. It differs from all other members of section *Chenopodium* in the total (or almost total) absence of vesicular hairs on the leaves, stems or flowers, and in the testa sculpture. In spite of being very different from *C. hybridum* morphologically, *C. polyspermum* may hybridize with this species, forming a hybrid known as *C.* ×*perhybridum* Ponert (1966). Aellen and Iljin (1936) placed *C. polyspermum*, together with *C. murale* L., in the series *Undata* Aellen & Iljin; however, in our opinion, these species are not closely related (see discussion below).

Chenopodium [sect. *Chenopodium*] subsect. **Urbica** (Standley) Mosyakin & Clemants, comb. nov. Basionym: *Chenopodium* I. *Urbica* Standley, North Amer. Fl. 21(1): 11. 1916 (name of uncertain rank). TYPE: *C. urbicum* L.

Folia deltoidea vel rhomboidea, margine denticulata vel rarius subintegra. Inflorescentia spicata, plerumque stricta et erecta. Semen margine obtusatum. Testa nitida, subglabra vel minutissime reticulata.

Leaves deltoid or rhombic, normally dentate or denticulate at margins (rarely almost entire). Inflorescence spicate, normally straight and erect. Seeds with obtuse margin. Testa shiny, almost smooth or indistinctly reticulate.

The sole member of this subsection, *C. urbicum*, differs from other members of *Chenopodium* sect. *Chenopodium* in the broadly deltoid (or rhombic-deltiod) leaves, seed margin rounded, and peculiar inflorescence with its branches in most cases almost appressed to the main stem. This subsection shows affinity (especially in the testa sculpture) to the next one (below). These two subsections differ particularly in the seed margin (rounded in subsection *Urbica*, acute in subsection *Undata*) and inflorescence (normally lax in *C. murale* s.l.). Strangely enough, in all versions of Aellen's system *C. urbicum* was placed in *Chenopodium* series (or subsect.) *Lejosperma* Aellen & Iljin.

Standley (1916) included in his *Urbica*-group *C. murale* L. and *C. mexicanum* Moquin-Tandon. We believe that these two species are not closely related to *C. urbicum*.

Chenopodium [sect. *Chenopodium*] subsect. **Undata** Aellen & Iljin ex Mosyakin & Clemants, subsect. nov. *Chenopodium* sect. *Chenopodia* C. A. Meyer series *Undata* Aellen & Iljin, Fl. SSSR 6: 54. 1936 (invalid name: Russian description). *Chenopodium* [sect. *Chenopodium*] subsect. *Undata* Aellen, in Aellen & Just, Amer. Midl. Naturalist 30: 75. 1943 (invalid name: English description); Aellen in Hegi, Illustr. Fl. Mitteleur., ed. 2, 3/2: 577. 1961 (invalid name: German description). TYPE: *C. murale* L.

Pericarpium minute punctulato-verrucosum. Inflorescentia cymosa vel cymoso-paniculata, plerumque laxa. Semen acute carinato-marginatum, subtiliter granulatum vel punctulatum.

Pericarp minutely verrucose-punctate. Inflorescence cymose or cymose-paniculate, normally lax. Seeds with acute or keeled margin; testa minutely punctate.

This subsection consists of *C. murale* s. str. and some taxa closely related to this species (e.g., *C. fasciculosum* Aellen). Members of this subsection differ from other species of *Chenopodium* sect. *Chenopodium* in the acute (sharply to bluntly keeled) seed margins, and testa marked with minute pits. This subsection seems to be closely allied to the preceding.

Chenopodium [sect. *Chenopodium*] subsect. **Leptophylla** (Standley) Clemants & Mosyakin, comb. nov. Basionym: *Chenopodium* IV. *Leptophylla* Standley, North Amer. Fl. 21(1): 14. 1916 (name of uncertain rank). TYPE: *C. leptophyllum* Nuttall ex S. Watson.

Synonym:

Chenopodium V. *Cycloidia* Standley, North Amer. Fl. 21(1): 16. 1916 (name of uncertain rank).

Folia linearia vel lineari-lanceolata, angusta; apice acuminata vel acuta, margine integerrima vel basi subhastata; uninervia vel plerumque trinervia (rarissime multinervia); saepissime griseo-farinosa vel olivaceo-virescentia. Testa subglabra.

Leaves linear or linear-lanceolate, narrow, acute or acuminate at apex; margins entire or hastately lobed at base; in most cases with only one (central) vein, or with additional one (rarely more) pair of lateral veins; mostly gray-farinose, or olive green. Testa smooth or nearly so.

This subsection brings together all the narrow-leaved *Chenopodium* species that form a close-knit, difficult group in the western United States and Canada (*C. leptophyllum* Nuttall ex S. Watson, *C. pratericola* Rydberg, *C. desiccatum* A. Nelson, *C. foggii* Wahl, *C. hians* Standley, *C. subglabrum* (S. Watson) A. Nelson, *C. cycloides* A. Nelson, *C. pallescens* Standley; possibly also *C. albescens* Small). There is some overlap with other subsections. Particularly, *C. albescens* appears to form an intermediate with *Chenopodium* subsect. *Chenopodium*, and *C. atrovirens* Rydberg forms a transition from this subsection to the next one (*Chenopodium* subsect. *Fremontiana*). More detailed discussion of the relationships within this group may be found in Crawford (1975) and La Duke and Crawford (1979). Species of this subsection were usually included by Aellen and his co-authors (Aellen, 1960; Aellen & Just, 1943; Aellen & Iljin, 1936) in the section *Chenopodia* C. A. Meyer series *Leiosperma* Aellen & Iljin (invalid name: see discussion below).

Chenopodium [sect. *Chenopodium*] subsect. **Fremontiana** (Standley) Clemants & Mosyakin, comb. nov. Basionym: *Chenopodium* VII. *Fremontiana* Standley, North Amer. Fl. 21(1): 18. 1916 (name of uncertain rank). TYPE: *C. fremontii* S. Watson.

Folia basalia et media saepissime trilobata; rarius subrotundata vel rotundato-ovalia, margine subintegra, plerumque non denticulata; plurimum tam longa quam lata. Testa glabra vel rarius minutissime striata. Odor subnullus.

Lower and medium cauline leaves normally ± trilobate, or sometimes almost rotundate or rotundate-ovate; margins almost entire (with the exception of basal lobes, when present), in most cases as long as wide or nearly so. Testa smooth or rarely indistinctly striate. Plants without rank odor (this last statement is necessary for distinguishing members of this subsection from *C. watsonii* s.l. and *C. vulvaria* and allied species).

This subsection includes the following species: *C. fremontii* S. Watson s.l. (including *C. pringlei* Standley), *C. atrovirens* Rydberg, *C. incanum* (S. Watson) A. A. Heller, *C. incognitum* Wahl, *C. nevadense* Standley, *C. glabrescens* (Aellen) Wahl, and *C. flabellifolium* Standley. They had previously been placed by Aellen (1960) and Aellen and Just (1943) mostly in *Chenopodium* subsect. *Lejosperma* (an invalid name). However, they appear to form a good and natural group allied to *Chenopodium* subsect. *Chenopodium* and *Chenopodium* subsect. *Favosa* (see discussion under the latter) and are geographically restricted mostly to the southwestern part of North America, and Central America (however, some South American taxa centered around *C. petiolare* Kunth possibly also belong here or, most probably, form their own group more distantly related to our subsection). These species all have more or less trilobate leaves, a rather glabrous pericarp, and smooth (or nearly smooth) testa.

Chenopodium [sect. *Chenopodium*] subsect. **Favosa** (Aellen) Mosyakin & Clemants, comb. nov. Basionym: *Chenopodium* series *Favosa* Aellen, Feddes Repert. 69: 69. 1964. *Chenopodium* subsect. *Cellulata* Aellen series *Favosa* ("*Foveosa*") Aellen in Hegi, Illustr. Fl. Mitteleur., ed. 2, 3, 2: 577. 1961 (invalid name: German description). TYPE: *C. ficifolium* Smith (lectotype, selected here).

Synonym:

Chenopodium sect. *Chenopodia* C. A. Meyer series *Cellulata* Aellen & Iljin, Fl. SSSR 6: 68. 1936 (invalid name: Russian description). *Chenopodium* subsect. *Cellulata* Aellen in Aellen & Just, Amer. Midl. Naturalist 30: 69. 1943 (invalid name: English description).

This subsection includes the following species: *C. ficifolium* Smith (including *C. blomianum* Aellen), *C. berlandieri* Moquin-Tandon s.l. (including *C. zschackei* J. Murr), *C. macrocalycium* Aellen, *C. bushianum* Aellen, *C. quinoa* Willdenow, *C. hircinum* Schrader, *C. watsonii* A. Nelson s.l. (an aggregate including also *C. palmeri* Standley, *C. arizonicum* Standley, and *C. neomexicanum* Standley). Some other species probably belonging to this group (mostly South American ones, e.g., *C. philippianum* Aellen) are in need of further taxonomic study. This is also true for a North American group, *C. watsonii* sensu lato, since it, evidently being related to *C. berlandieri*, at the same time closely approaches morphologically some forms of the *C. fremontii* aggregate, and possibly may be included together with the latter in *Chenopodium* subsect. *Fremontiana*. See Wilson (1976), La Duke and

Crawford (1979), and Walters (1985, 1988) for discussions of relationships within this group and relationships to representatives of other subsections (in particular, with the preceding subsection).

Chenopodium [sect. *Chenopodium*] subsect. **Cicatricosa** (Aellen) Mosyakin & Clemants, comb. nov. Basionym: *Chenopodium* series *Cicatricosa* Aellen, Feddes Repert. 69: 69. 1964. *Chenopodium* subsect. *Cellulata* Aellen series *Cicatricosa* Aellen in Hegi, Illustr. Fl. Mitteleur., ed. 2, 3/2: 577. 1961 (invalid name: German description). TYPE: *C. acerifolium* Andrzejowski (lectotype, selected here).

This group consists of the following species: *C. acerifolium* Andrzejowski (including *C. klinggraeffii* (Abromeit) Aellen), *C. suecicum* J. Murr s.l. (including some Eurasian and possibly North American hexaploid forms of this mostly diploid species), *C. karoi* (J. Murr) Aellen, and *C. jenissejense* Aellen & Iljin.

Almost all representatives of this subsection (except *C. suecicum*) are predominantly non-weedy species of alluvial, riparian, and other similar marginal habitats, occurring mostly in temperate and northern Eurasia. They differ from representatives of *Chenopodium* subsect. *Chenopodium* in having less smooth, in most cases indistinctly foveolate or foveolate-striate testa. However, they are morphologically connected to both *Chenopodium* subsect. *Chenopodium* and *Chenopodium* subsect. *Favosa* (by *C. suecicum* and *C. karoi*, respectively). An excellent but somewhat outdated discussion of the relationships between species of this subsection and *C. ficifolium* may be found in Aellen (1929). The group is extremely interesting from the phytogeographical point of view, and is in need of a more detailed taxonomic study.

Chenopodium [sect. *Chenopodium*] subsect. **Standleyana** Mosyakin & Clemants, subsect. nov. TYPE: *C. standleyanum* Aellen.

Synonym:

Chenopodium VI. *Bosciana* Standley, North Amer. Fl. 21(1): 16. 1916 (name of uncertain rank).

Plantae gracile erectae, plerumque ramosae; inflorescentia gracilissima moniliformia. Laminae foliorum tenues, plerumque trilobatae vel subintegrae. Semina non manifeste picta vel minutissime foveolata.

Plants mostly gentle, erect, branched. Inflorescence moniliform, with small loosely disposed glomerules (often having flowers in various stages of development). Leaf blades normally thin, trilobate or occasionally almost entire. Seed testa almost glabrous or indistinctly minutely pitted.

The following species are included in this subsection: *C. bryoniifolium* Bunge (= *C. koraiense* Nakai s. str.; *C. atripliciforme* J. Murr s. str.), *C. gracilispicum* Kung (*C. koraiense* auct. p.p.), ? *C. badachschanicum* Tzvelev (*C. atripliciforme* J. Murr, p. p.), *C. standleyanum* Aellen (*C. boscianum* auct.), *C. missouriense* Aellen emend. Dvořák (1987).

We prefer not to use the name *Bosciana*, since *C. boscianum* Moquin-Tandon seems to be a synonym (or infraspecific entity) of *C. berlandieri* s.l., and was commonly misapplied for a species now known as *C. standleyanum*. Moreover, Standley (1916) included in this group such species as *C. carnosulum* Moquin-Tandon, *C. nevadense* Standley, and *C. albescens* Small, which, in our opinion, do not belong here.

We accept the species *C. missouriense* in the narrow sense, as it was delimited and lectotypified by Dvořák (1987), since most of the specimens in North American herbaria determined as *C. missouriense* in fact represent various forms of *C. strictum* and (less commonly) *C. album*. The placement of *C. badachschanicum* is rather tentative: this little-known Asian species also shows some similarity with the *C. karoi* aggregate.

We include here species with rather smooth testa (similar to *Chenopodium* subsect. *Chenopodium*), but it is necessary to note that they are closely connected to some species of the preceding subsection (especially to *C. karoi* and *C. suecicum*) by evident morphological transition, since minute characters of testa sculpture may vary considerably (from deeply and prominently sculptured to almost glabrous) within groups of closely related taxa, which is evident from the example of *C. hybridum* sensu lato. Representatives of this subsection (as well as of the preceding one) are also mostly non-weedy species of alluvial and disturbed semi-natural habitats (river banks, forest margins, eroded slopes, etc.).

Chenopodium [sect. *Chenopodium*] subsect. **Chenopodium**. TYPE: *C. album* L. (lectotype of the genus).

Synonyms:

Chenopodium IX. *Alba* Standley, North Amer. Fl. 21(1): 21. 1916 (name of uncertain rank).

Chenopodium sect. *Chenopodia* C. A. Meyer series *Lejosperma* Aellen & Iljin, Fl. SSSR 6: 59. 1936 (invalid name: Russian description). *Chenopodium* sect. *Chenopodium* subsect. *Leiosperma* Aellen in Aellen &

Just, Amer. Midl. Naturalist 30: 61. 1943 (invalid name: English description); Aellen in Hegi, Illustr. Fl. Mitteleur., ed. 2, 3/2: 578. 1961 (invalid name: German description).

This subsection includes *C. album* L. sensu latissimo, *C. strictum* Roth s.l., *C. opulifolium* Schrader ex A. P. De Candolle and some other species, mostly those segregated from the above taxa. *Chenopodium vulvaria* L. and several similar Eurasian taxa (e.g., *C. sosnowskii* Kapeller, *C. pamiricum* Iljin, *C. nidorosum* Otschiauri, *C. iljinii* Goloskokov) may be included here provisionally; however, they also demonstrate an evident similarity with the *C. acerifolium–C. karoi* complex, and possibly after additional study they should be separated into their own subsection.

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